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AUTHOR O'Donnell, J. P.; And Others
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ABSTRACT

The study compared the Halstead-Reitan (H-R) neuropsychological test profiles of 25 normal, 47 learning disabled (LD) and 20 brain damaged (BD) young adults. Multivariate analyses indicated that the H-R battery could differentiate these groups beyond chance expectancy and that the neuropsychological deficits in LD performance are intermediate in severity between normals and BD. In an investigation of subtypes of LD based upon their neuropsychological test performance, multivariate analyses suggested that LD young adults can be subdivided into those with mild (low LD) and those with more noticeable (high LD) cerebral dysfunctioning. Measures of mental flexibility seemed most sensitive to normal-low LD group differences. Further, there were significant differences in the performance of normal, low LD, high LD and BD groups on the Rey Auditory-Vocal Learning Tests. Differences were due to qualitative differences in information processing. (Author/CL)

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NEUROPSYCHOLOGICAL TEST FINDINGS IN NORMAL, LEARNING-DISABLED AND BRAIN-DAMAGED YOUNG ADULTS

J. P. O'Donnell, J. Kurtz, N. V. Ramanaiah

Southern Illinois University

Midwestern Psychological Association

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ABSTRACT

The major purpose of this study was to compare the Halstead-Reitan (H-R) neuropsychological test profiles of Normal, Learning-Disabled (LD), and Brain-Damaged (BD) young adults. Multivariate analyses indicated that the H-R battery could differentiate these groups beyond change expectancy and that the neuropsychological deficits in LD performance are intermediate in severity between normals and BD.

A second purpose of this research was to investigate subtypes of LD based upon there neuropsychological Test performance. Multivariate analyses suggested that LD young adults can be subdivided into those with mild (low LD) and those with more noticeable (high LD) cerebral dysfunctioning. Measures of mental flexibility seem most sensitive to Normal-Low LD group differences. Furthermore, there were significant differences in the performance of Normal, Low LD, High LD and BD groups on the Rey Auditory-Verbal Learning Test. These differences were due to qualitative differences in information processing among these groups.

METHOD

SUBJECTS

Normals. One skilled laborer and 29 college student volunteers comprised the normal group. According to their verbal reports, none had a history of learning problems or had experienced either seizures or unconciousness following a blow to the head. (See Table 1.)

Learning Disabled. All LD had been independently diagnosed during the primary or secondary grades and all had been involved in special class placements. All had either completed high school or were within one semester of graduation. (See Table 1.)

Brain Damaged. All BD were victims of head trauma sustained either in industrial accidents (n = 3) or in motor vehicle accidents (n = 17). Eighty-nine percent had been comatose for longer than one week following their accidents and all had received neurological diagnoses indicating brain injury. All BD were either gainfully employed or attending school at the time of their accidents and 95% had graduated from high school. All BD were tested 9 months or more after their accidents, at a time when their medical conditions were stable. (See Table 1.)

TESTS AND PROCEDURES

Each S was administered the Halstead-Reitan Battery, Trail Making Test and Rey Auditory-Verbal Learning Test according to standardized instructions, by a trained examiner, with care being taken to elicit each Ss best performance. The tests and their respective scores were as follows:

Test Name	Score	Measure Of . . .
Category Test	Errors	Concept Formation
Tactual Perform, Test - Time	Total Time - 3 Trials	Psychomotor Problem Solving
Tactual Perform, Test - Memory	No. Blocks Recalled	Incidental Memory
Tactual Perform, Test - Location	No. Blocks Correctly Localized	Spatial Visualization
Seashore Rhythm Test	Scaled Score; 1 = Best	Attention; Concentration
Speech Perception Test	Errors	Auditory Perception
Finger Tapping	Average No. of Taps	Motor Speed
Trail Making Test - A	Time	Visual Scanning
Trail Making Test - B	Time	Mental Flexibility
Auditory-Verbal Learning Test	Frequency Correct	Verbal Learning & Memory
	Pair Frequency	Subjective Organization & Information Processing

RESULTS

1. In Table 2, notice that significant E's emerge for each measure. Post-hoc Duncan's tests indicate:

   (a) Normals and LD have "better" scores than BD on all measures.

   (b) Normals have significantly "better" scores than LD on all measures except TPT-Memory.

2. Linear Discriminant Function Analysis (LDFA) yields two significant functions. The canonical correlations associated with these functions are .82 and .37, respectively.

3. Table 3 shows the classification matrix from the LDFA based on the 9 scores shown in Table 2.

   (a) There is no overlap between Normal and BD. There is a 20% to 30% misclassification between adjacent groups.

   (b) Cross-validation using the jackknife procedure correctly classifies 64% of all Ss.

4. Figure 1 shows the proportion of each group at different levels of the Halstead Impairment Index (HII). There is no overlap between Normal and BD; LD span the entire range of this index; and 36% of LD exhibit an HII suggesting Brain Dysfunction. For LD the Median HII is 0.3.

5. In order to investigate possible subgroups of LD we divided our LD Ss at the median, dropped all Ss with HII = 0.3 (3 Normals; 15 LD), and formed four groups: Normal (n = 25); Low LD (HII 0.1; n = 25); High LD (HII o.4; n = 22); and BD (n = 20). Table 4 shows means, standard deviations and univariate E's for these four groups. Post -hoc tests indicate:

(a) Normals and Low LD differ from BD on all measures.

(b) Normals differ from High LD on all measures except Trails A.

(c) Low LD differs from High LD on all measures except Trails A and B.

(d) Although Normals and Low LD fail to differ significantly on any measure, the Normal-Low LD difference on Trails B approaches significance ($.05 > p < .10$).

6. LDFA was again performed and the canonical correlations for the three significant functions are .91, .52, and .38.

7. The classification matrix in Table 5 shows that approximately 70% to 80% of the Ss in each group are correctly classified. Misclassifications are principally between Normal and Low LD and between High LD and BD. Cross validation using the jackknife procedure correctly classifies 66% of all Ss.

8. In an effort to more systematically assess cognitive processing in our Ss, we administered the Rey Auditory Verbal Learning Test.

The list of 15 words was presented orally at the rate of one word per second. A multi-trial free recall paradigm was employed for 5 trials. Following the free recall of a second interpolated 15-word list, a sixth free recall trial was recorded for the initial list (with no further list presentations). Dr. Robert C. Radtke is collaborating in the analyses of these data.

9. Figure 2 depicts the mean frequency of words correctly recalled across trials for the four groups.

   (a) Despite overlap in HII, Low LD are different from Normals and High LD are different from BD at each trial point.

   (b) With the exception of Trial 1, there are significant differences between Low LD and High LD at each trial point.

   (c) These findings tend to confirm the distinctiveness of the Low LD and High LD groups.

10. Figure 3 summarizes our analyses of the development of subjective organization using the Pair Frequency Index (PF) recommended by Sternberg and Tulving (1977). The PF measure is based upon Ss consistently recalling the same words in adjacent positions across trials and is independent of the total words recalled.

   (a) For Trial 2 - 5, the significant Group by Trials interaction indicates that the increase is greater

for Normals than for the clinical groups.

(b) For the Trial 5 - 6 (recall) segment, the significant Group by Trials interaction indicates that Normals and Low LD place increasing reliance on organization during recall. HOWEVER, High LD and BD rely even less on organization established during Trials 2 to 5.

CONCLUSIONS

1. These data confirm, once again, the validity of the H-R battery in that ANOVAs and LDFA reveal clear differences between Normals and BD.

2. The analyses also indicate that, on a dimension of severity of cerebral dysfunctioning, LD are intermediate between Normals and BD.

3. The second LDFA suggests the possibility of further subdividing LD into midly impaired (Low LD) and moderately impaired (High LD) groups.

4. The frequency correct data from the Auditory-Verbal Learning Test tend to confirm this subdivision into Low LD and High LD.

5. Furthermore, the PF analyses suggest that there are qualitative differences in information processing between these Low LD and High LD groups. The Low LD process information more slowly, but in a way similar to Normals. The High LD process information much differently and appear to be more similar to our head-injured subjects.

Table 1. Group Characteristics

	Normal		Learning Disabled		Brain Damaged	
	M	SD	M	SD	M	SD
N	30		60		20	
Age	20.0	1.9	19.2	2.0	25.0	3.5
Education (Years)	13.7	1.4	12.1	1.1	12.7	1.5
VIQ	116.2	11.3	104.9	10.4	96.3	13.9
PIQ	116.4	11.6	107.5	11.3	89.5	10.8
FSIQ	117.1	10.3	106.4	9.5	93.0	10.5
Sex (% Male)	70%		87%		75%	
Handedness (% Right)	90%		87%		95%	
Coma (Days)					52.5	53.3
Time Since Accident (Mos.)					39.7	22.1

Table 2. Means and Standard Deviations.

Variable	Normal		Learning Disabled		Brain Damaged		E
	M	SD	M	SD	M	SD	
Category	24.9	15.9	43.4	30.0	60.4	27.6	11.2[B]
TPT-Time	10.4	2.2	12.9	5.4	25.5	7.0	58.7[B]
TPT-Memory	8.7	0.8	8.1	1.4	6.4	1.8	17.5[B]
TPT-Localization	6.4	2.0	5.0	2.3	2.2	1.6	22.9[B]
Rhythm	3.4	2.4	5.1	2.7	5.5	2.8	5.9[A]
Speech	3.1	1.7	5.3	4.0	10.1	5.1	21.0[B]
Tapping (Dom.)	51.3	5.5	50.8	6.3	29.7	16.9	45.8[B]
Trails - A	21.0	4.6	28.5	9.8	71.8	66.4	21.1[B]
Trails - B	49.9	12.8	81.2	30.0	139.5	77.1	30.3[B]

[A] $P < .01$ [B] $P < .001$

Table 3. Classification Matrix

		Into Group: Normal	LD	BD
From Group	Normal	83%	17%	0%
	LD	32%	63%	5%
	BD	0%	20%	80%

72% of all subjects correctly classified.

Table 4. Means And Standard Deviations.

Variable	Normal (n = 25)		Low LD (n = 25)		High LD (n = 22)		Brain Damaged (n = 20)		E
	M	SD	M	SD	M	SD	M	SD	
Category	24.3	16.3	35.0	20.3	60.5	35.3	60.4	27.6	11.9[B]
TPT - Time	10.5	2.4	9.2	2.1	17.4	5.4	25.5	7.0	60.5[B]
TPT - Memory	8.7	0.7	8.6	0.9	7.3	1.6	6.4	1.8	14.9[B]
TPT - Localization	6.9	1.7	6.2	2.0	3.7	2.4	2.2	1.6	28.0[B]
Rhythm	3.1	2.0	3.0	2.3	7.9	3.4	6.6	2.8	20.2[B]
Speech	3.1	1.6	3.6	2.0	7.5	5.3	10.1	5.1	17.2[B]
Tapping (Dom.)	51.7	5.6	55.1	4.0	46.0	6.1	29.7	16.9	32.7[B]
Trails - A	21.3	4.9	26.5	9.2	32.3	10.5	71.8	66.4	11.1[B]
Trails - B	49.6	12.3	71.8	16.6	95.4	38.9	139.5	77.1	18.4[B]

[B] $P < .001$

Table 5. Classification Matrix.

		Into Group			
		Normal	Low LD	High LD	Brain Damage
From Group	Normal	80%	16%	4%	0%
	Low LD	16%	80%	4%	0%
	High LD	5%	0%	86%	9%
	Brain Dam.	0%	0%	30%	70%

79% of all subjects correctly classified.